

Erthwrks Example Calculations - Method 19

Nomenclature

MGV	Molar gas volume, volume of gas at standard conditions, scf/lbmol
V	Volume, ft ³
n	Moles, lb/mol
F _d	Fuel F Factor, scf/MMBtu
F _H	Fuel Heating Rate (MMBtu/hr)
H _p	Engine horse power during test, hp
GHV	Gross Heating Value (BTU/scf), based on vapor analysis

Constants

R	10.7316 Universal gas constant, ft ³ psi / R lbmol
T _s	527.67 Standard Temperature, R
P _s	14.696 Standard Pressure, psi
MW _{TOC}	44.0962 Molecular Weight of TOC as propane, lb/lbmol
F _d	8855 Fuel F Factor for Vapor Gas—Method 19 value, scf/MMBtu
GHV	2305 Gross Heating Value, BTU/scf
FF _{SCFM}	39 Fuel flow to the VCU, Run 1, standard cubic feet per minute
FF _{SCFH}	2357 Fuel flow to the VCU, Run 1, standard cubic feet per hour
PPM _{TOC}	51.3 Concentration of TOC at exhaust, Run 1, parts per million
%O _{2d}	17.96 Oxygen concentration measured on a dry basis, Run 1, %
Conv _{lb-g}	453.6 Number of grams in one pound

Molar gas volume (MGV) calculation at standard conditions (Ideal Gas Law)

$$\begin{aligned} \text{MGV} &= \frac{V}{n} = \frac{R * T_s}{P_s} \\ \text{MGV} &= \frac{V}{n} = \frac{10.7316 * 527.67}{14.696} \\ \text{MGV} &= 385.325 \frac{\text{scf}}{\text{lbmol}} \end{aligned}$$

Emission Concentration, C_{TOC}, lb/scf (For TOC, Run 1)

$$\begin{aligned} C_{\text{TOC}} &= \frac{\text{PPM}_{\text{TOC}} * \text{MW}_{\text{TOC}}}{\text{MGV}} * 10^{-6} \\ C_{\text{TOC}} &= \frac{51.35 * 44.0962}{385.325} * 10^{-6} \\ C_{\text{TOC}} &= 5.88E-06 \frac{\text{lb}}{\text{scf}} \end{aligned}$$

Emission Rate Calculation, E_(lb/MMBtu), (For TOC, Run 1)

$$\begin{aligned} E_{(\text{lb/MMBtu})} &= C_{\text{TOC}} * F_d * \frac{20.9}{20.9 - \%O_{2d}} \\ E_{(\text{lb/MMBtu})} &= 5.88E-06 * 8855 * \frac{20.9}{20.9 - 17.96} \\ E_{(\text{lb/MMBtu})} &= 0.370 \frac{\text{lb}}{\text{MMBtu}} \end{aligned}$$

Emission Rate Calculation, F_H, (MMBtu/hr)

$$\begin{aligned} F_H &= \frac{FF_{\text{SCFH}} * GHV}{1000000} \\ F_H &= \frac{2357 * 2305}{1000000} \\ F_H &= 5.43 \end{aligned}$$

Emission Rate Calculation, E_(lb/hr), (For TOC, Run 1)

$$\begin{aligned} E_{(\text{lb/hr})} &= E_{(\text{lb/MMBtu})} * F_H \\ E_{(\text{lb/hr})} &= 0.370 * 5.43 \\ E_{(\text{lb/hr})} &= 2.01 \frac{\text{lb}}{\text{hr}} \end{aligned}$$